

The Molluscan Fauna of the Cocos-Keeling Islands, Indian Ocean¹

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Little has been published on the molluscan fauna of the Cocos-Keeling Islands. A list of 25 species determined by E. A. Smith was published in an appendix to "Corals and Atolls" in 1912 by F. Wood-Jones. Isolated records have appeared in the molluscan literature from time to time. These have been mainly from the collection of the British Museum where Cocos-Keeling material was deposited by Charles Darwin, H. O. Forbes, and F. Wood-Jones.

In the autumn of 1941, Doctor C. A. Gibson-Hill, now Curator of Zoology at the Raffles Museum in Singapore, collected a representative series of 163 species of molluscs in this group of islands. These were kindly forwarded in 1947 to the United States National Museum for identification. One series has been retained by the Division of Mollusks, and the duplicates returned to the Raffles Museum. All native names, economic, and ecologic remarks are from notes supplied by Doctor Gibson-Hill, and when introduced into the text are included in quotation marks. In a few instances, no specific locality for specimens was given; when such information is omitted they came from some point on the main atoll of the Cocos-Keeling Islands. The Malayan word Pulo means island, and localities such as Pulo Selma, Pulo Panjang, etc. are in the ring of islands surrounding the Cocos or Main Atoll.

The Cocos-Keeling group lies in the eastern portion of the Indian Ocean, $12^{\circ} 9'$ south of the equator, and $96^{\circ} 53'$ east of Greenwich; it is 600 miles southeast of Java and some 500 miles east southeast of Christmas Island. The main atoll, known as Cocos, consists of a ring of about 24 islands. Keeling Island lies 15 miles to the north. Illustrated accounts of the group are given by F. Wood-Jones (1912) and C. A. Gibson-Hill (1947 & 1948).

J. R. Le B. Tomlin's article (1935) on "The Marine Mollusca of Christmas Island, Indian Ocean" has been mentioned through-

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out the report to record the species common to both island groups. E. A. Smith (in Wood-Jones 1912) records from Cocos Atoll only one marine gastropod, *Fossarus trochlearis* A. Adams, which was not collected by Doctor Gibson-Hill.

The nine species of land molluscs included in the collection do not reveal much information on zoogeographic relationships. Two species, *Subulina octona* Bruguiere and *Lamellaxis (Allopeas) gracilis* Hutton, are undoubtedly introduced. The zonitid, *Liardetia (Liardetia) sculpta* Moellendorff, is known also from southern China, the Marianas and Carolinas, and may represent a recent introduction by man. A single specimen of *Gastrocopta* was sufficiently broken to prevent identification. One new species of *Succinea*, apparently restricted to the Cocos-Keeling Islands is described in this article. The three species of *Melampus* are widespread Indo-Pacific forms. A single, beach worn specimen of *Pythia* was probably washed ashore after floating from some point in the East Indies, perhaps Sumatra.

The 154 species of marine molluscs in this collection are a mixture of the typical Indian Ocean fauna and that of the Western Pacific. The geographic distribution of a great number of species is so insufficiently known or they show such little racial variation that at present they must be considered as being widespread in their distribution from the West Coast of Africa to Polynesia in the Eastern Pacific.

Synonyms have been included only under those species which have recently undergone a nomenclatorial change or were in need of clarification.

Doctor W. J. Rees, curator of the Mollusca Section in the British Museum, has kindly identified and made notes on the cephalopods. His information is included as Appendix A at the end of this paper.

Family TROCHIDAE

Trochus (Infundibulum) maculatus Linné 1758.

Native name: Siput Topi China; Siput Tutut.

Abundant in the deeper waters at the south end of the lagoon. This is a widely distributed Indo-Pacific species.

Family TURBINIDAE

Turbo (Turbo) petholatus Linné 1758.

This common Indo-Pacific species "occurs in the shallow, weedy water along the east side of the Cocos Atoll Lagoon, to the south of Pulo Selma. Its flesh is eaten, and the operculum used for broaches."

Turbo (Marmorostoma) argyrostomus Linné 1758.

Native name: Kēpala Viola.

"This species is very plentiful over the outer half of the barrier. It is much sought by the Malays, the flesh being eaten boiled or in soup."

Turbo (Marmorostoma) iajonkairii Deshayes 1839.

This uncommon species was also recorded by Tomlin (1935) from Christmas Island. It appears to be limited to the Indian Ocean and East Indies.

Family NERITIDAE

All of the Neritidae listed below are widespread Indo-Pacific species. The subgeneric partitioning is that of J. Thiele, but considerably more study is needed to ascertain the true values of these subgenera, especially since some recent workers have been raising them to generic standing.

Nerita (Ritena) plicata Linné 1758.

A common Indo-Pacific species which is "abundant among the rocks in shallow water inside the Cocos-Keeling lagoon."

Nerita (Ritena) undata Linné 1758.

This species "was found on the inner portion of the fringing reef, behind Pulo Tikus."

Nerita (Theliostyla) albicilla Linné 1758.

This species also "was found on the inner portion of the fringing reef, behind Pulo Tikus," together with the following species.

Nerita (Amphinerita) polita Linné 1758.

This species "was found on the inner portion of the fringing reef, behind Pulo Tikus."

Nerita (Cymostyla) costata Gmelin 1791.

Only one specimen was collected at Cocos-Keeling. This species is figured by Chemnitz in Conchyl. Cab., 5, figs. 1966 and 1967, and is the *grossa* of Born 1780, non Linné 1758. It was recorded by Tomlin (1935) from Christmas Island.

Family LITTORINIDAE

Littorina undulata Gray 1839.

Three specimens "found on North Keeling and a dozen in shallow, weedy water inside the lagoon near Pulo Selma." A very widespread and common Indo-Pacific species.

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Littorina obesa Sowerby 1832.

One large specimen from North Keeling.

Littorina scabra Linné 1758.

A single specimen from Pulo Selma.

Family RISSOIDAE

Rissoina plicata A. Adams 1851.

Four specimens were recovered from the intestine of two holothurians from the lagoon at Cocos. They had been ingested with small bits of coral and sand. This is a common widespread Western Pacific species.

Family CERITHIIDAE

Additional careful work is needed to clarify the use and rank of the subgenera listed below: *Rhinoclavis* Swainson 1840 (= *Vertagus* Schumacher 1817, non Link 1807); *Clypeomorus* Jousseaume 1888; *Contumax* Hedley 1899 and others which have been used interchangeably with *Cerithium* of authors.

Cerithium (Rhinoclavis) vertagus Linné 1767.

Beach drift at Pulo Panjang. This is a common Indian Ocean species which spreads into the Western Pacific.

Cerithium (Rhinoclavis) sinensis Gmelin 1791.

This common Indo-Pacific species was "found abundant in the shallow, weedy water inside the lagoon at Pulo Panjang." *Cerithium (R.) obeliscus* Bruguière 1792 is a synonym.

Cerithium (Rhinoclavis) asper Linné 1758.

Found with the preceding species.

Cerithium (Contumax) echinatum Lamarck 1822.

A single specimen found with the preceding species.

Cerithium (Contumax) columnna Sowerby 1855.

Common in the lagoon at Pulo Panjang.

Cerithium (Cerithium) nodulosum Bruguière 1792.

Common at Pulo Panjang and Pulo Siput.

Cerithium (Clypeomorus) sejunctum Iredale 1929.

Plentiful in the lagoon in shallow, weedy water. Also found at North Keeling. This species is *C. variegatum* Quoy and Gaimard (non *G. Fischer* 1807; non *Menke* 1829). Iredale (1929) proposed a new name for this homonym.

Family EULIMIDAE

?Stylifer dubia Sowerby 1878.

One specimen of a young *Stylifer* was found embedded in the arm of the starfish, *Ophidiaster granifer* Lutken (*fide* Austin H. Clark). In most respects resembles *Stylifer dubia* "Baird" Sowerby 1878, Conch. Icon., 20, *Stylifer*, pl. 1, fig. 8 (New Calendonia), but reliable identification awaits comparison with the type of *dubia*. The Cocos-Keeling specimen is also rather close to *Stylifer thaanumi* Pilsbry but has two instead of three glossy nuclear whorls as in the Hawaiian species. The visceral tissue surrounding the digestive gland and the flesh of the body and foot are mottled with granular-like clumpings of brilliant red. The entire shell is enwrapped with a colourless pouch-like, fleshy extension of the mantle. Welded to the inner surface of the small mantle proper is a set of low, plate-like, gill lamellae. The tube-like extension anterior to the proboscis is about two or three times as long as the shell and extends into the coelomic cavity of the starfish. Length of shell 2.5 mm; width 1.6 mm. The glossy nucleus projects through the tiny hole made in the integument of the starfish. No operculum or radula.

Family STROMBIDAE

Strombus gibberulus Linné 1758.

This species was found to be fairly abundant on the outer beaches of the Atoll. The material in the United States National Museum suggests that these specimens belong to a geographical race which extends from Natal and the Gulf of Suez through India and Mauritius to Cocos-Keeling. We hesitate to accept or give a name to this possible subspecies because of lack of material. Colonies of the Indian Ocean race are characterized by the large size of the specimens (some over two inches in length) and the prominence of raised spiral cords on the entire surface of the body whorl. This race is figured by Duclos 1844, in Chenu, Illustrations Conchyliologiques, 4, pl. 14, fig. 1, pl. 15, figs. 3, 5. A few Philippine and Melanesian specimens reach a size of two inches, and on rare occasion the spiral cords, always present on the lower third of the body whorl, spread up over the whorl as in the Indian race. This character of spiral cords is present in varying frequency among several other species of *Strombus*. A comparable case exists in Western Atlantic species *Strombus pugilis pugilis* Linné and its geographical race *S. pugilis nicaraguensis* Fluck (see Clench and Abbott, 1941). This was not recorded from Christmas Island by Tomlin where undoubtedly it exists.

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Strombus lentiginosus Linné 1758.

Three adult specimens found on the outer beach at Pulo Panjang. This is a widely distributed Indo-Pacific species, and was also recorded by Tomlin from Christmas Island.

Strombus flammeus Link 1807.

Lambis flammea Link 1807, Beschr. Nat. Samml., Rostock, p. 108 (refers to Martini Conch. Cab., 3, p. 96, fig. 799).

Strombus floridus Lamarck 1822, Anim. sans Vert., 7, p. 211, (refers to Martini Conch. Cab., 3, figs. 807-809; Lister, Conch. and others).

Strombus mutabilis Swainson 1822, Zool. Illustr., pl. 71, fig. 1.

Strombus epimelus Duclos 1844, in Chenu, Illustr. Conch., 4, p. 3, pl. 16, figs. 11, 12, pl. 22, figs. 5, 6.

Strombus flosculosus Martyn, Mörch, 1852 Cat. Conch. Yoldi, (la), p. 63 (= *Canarium flosculosum* Martyn (non-binomial) 3, p. 85, figs. 807-809).

This species is more abundant on Cocos Atoll than *S. gibberulus* Linné. The synonymy of this species is given in detail, since it has been known under the name of *S. floridus* Lamarck for many years. Although the Cocos-Keeling specimens are well striated like *gibberulus*, this character shows up equally well in Melanesian and Polynesian material, and it appears that the Indian Ocean forms cannot be morphologically separated as distinct races.

Lambis lambis Linné 1758.

Native name: Siput Beri-kaki.

Apparently this species is common in the lagoon of Cocos Atoll. "The Malays eat the soft parts, boiled or as soup." This is the commonest and most widely distributed *Lambis* of the Indo-Pacific region.

Lambis truncata Humphrey 1786.

Strombus truncatus Humphrey 1786, Portland Catalogue, p. 133, no. 2967 (refers to Davila 1, 1767, pl. 12 and 14).

Strombus bryonia Gmelin 1791, Syst. Nat., ed. 13, p. 3520, no. 33 (refers to Martini Conch., 3, pl. 93, figs. 904, 905).

Lambis davillae Röding 1798, Museum Boltenianum, 2, p. 66 (refers to Davila, 1, 1767, pl. 13, 14; Chemn. 10, pl. 158, fig. 1512).

"This species, which is plentiful, is found in weedy, slightly coral-strewn, shallow water inside the lagoon. The Malays eat the soft parts, boiled or as soup." This is the largest of the *Lambis* species, and was known as *Pterocera bryonia* Gmelin 1791 until recently. Solander is often considered the author of the Portland Catalogue.

Lambis chiragra Linné 1758.

Strombus chiraga Linné 1758, Syst. Nat., p. 742, no. 423 (Bandam Asiae) (refers to Bonani, 3, pl. 312; Rumphius Mus. pl. 35, figs. A, B, C; Gault. test. pl. 35, figs. A, B, pl. 26, fig. B).

Strombus cancer Humphrey 1797, Museum Calonnianum, p. 39, no. 39, no. 729 (non-binomial).

Native name: Siput Béri-kaki Laki-laki (adults).

Siput Béri-kaki Pèrempuan (young).

Reported as plentiful in the shallow pools over the greater part of the barrier reef on Cocos Atoll. "The Malays eat the flesh, boiled or as soup." The large series before us are typical of *chiragra* Linné which, judging from the records in the United States National Museum, is common in the Philippines, Melanesia, Micronesia, and the Ryukyu Islands.

All of the eleven young specimens from Cocos-Keeling possess a dark brown band within the aperture on the spire end of the columella.

There still seems to be some doubt as to the nature of *Lambis arthritica* Röding (=*rugosa* Sowerby). It is quite possible that *arthritica* Röding is a subspecies of *chiragra* with an Indian Ocean distribution. In a few localities, such as the Marshall Islands, the shells show a combination of the respective characters of these two species. *L. arthritica* Röding is smaller, not as elongate, with heavy whitish cream plications in the aperture between which are dark purplish streaks. In *L. chiragra* Linné, these plications are much weaker and usually further back in the rosy cream aperture. The top row of tubercles on the body whorl of *arthritica* are smaller and all about the same size, while in *chiragra*, the last two tubercles are usually fused to form a larger more elongate one. There seems to be a certain amount of variation in the position of the second long spine near the spire in each species, although in *arthritica* the spine is never exactly in line with the axis of the spire as is most often the case in *chiragra*. We are appending the synonymy of *arthritica* below. More material with accurate data will probably solve the validity of *arthritica*. Linné's reference, in his description of *chiragra*, to Gualtieri pl. 35, fig. B could be chosen as the most suitable figure. His other references appear to be a mixture of what Martini figured on pl. 87, fig. 856 and 857 (=*arthritica* Röding) and his own *chiragra*.

Lambis chiragra arthritica Röding 1798.

Lambis arthritica Röding 1798, Museum Boltenianum, 2, p. 67, (refers to Martini Chemn., 3, pl. 87, fig. 857).

Pteroceras rugosum Sowerby 1842, Thesaurus Conchyl., 1, p. 42, pl. 11, figs. 9, 10 (South Seas).

Not found at Cocos-Keeling. See above.

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Family NATICIDAE

Polinices melanostoma Gmelin 1791.

Found in pools on outer barrier reef.

Polinices mammilla Linné 1758.

Natica marochiensis Gmelin 1791.

Abundant in the shallow, weedy waters of Cocos lagoon.

Family OVULIDAE

Ovula ovum Linné 1758.

Native name: Siput Puteh.

"Occasionally found in the outer barrier pools, especially at the north-east corner of the Atoll." This is a fairly common species in the Indo-Pacific region, although it becomes quite rare in the Central Pacific. The International Commission of Zoölogical Nomenclature at one of its recent sessions in Paris has ruled that the names in the Index by Gronovius for Meuschen's Museum Gronovianum (1781) are not nomenclaturally available. Therefore Bruguière's genus *Ovula* cannot be replaced by *Amphiperas* Gronovius 1781.

Family CYPRAEIDAE

Cypraea (Staphylaea) nucleus Linné 1758.

"A single live specimen was found on the outer edge of the barrier reef between Pulo Béras and Pulo Gangsa." This species is not uncommon with a range extending from Madagascar to the Central Pacific and Japan.

Cypraea (Erosaria) labrolineata Gaskoin 1848.

"A single living specimen was found under a coral boulder in a pool on the outer portion of the barrier reef between Pulo Béras and Pulo Gangsa."

Cypraea (Erosaria) poraria Linné 1758.

"Found alive under boulders on the outer section of the barrier reef of Cocos Atoll." There are, according to the Schilders, only two races of this species and the one at Cocos Atoll is the typical race which occurs in the Central Indian Ocean as far east as Java and N. W. Australia. The other race, *scarabaeus* Bory 1827, ranges from Japan and Queensland to Polynesia. This species is rare to moderately frequent.

Cypraea (Erosaria) erosa Linné 1758.

Three living specimens were found in pools on the outer portion of Cocos Atoll between Pulo Tikus and Pulo Gangsa, and a fourth specimen, lacking the characteristic lateral color

blotches, was found under coral boulders between Pulo Beras and Pulo Gangsa. This species is widespread from South Africa to Polynesia.

Cypraea (Erosaria) helvola Linné 1758.

From pools on the outer edge of the barrier, between Pulo Gangsa and Pulo Selma. There are seven races of this species extending from East Africa through the Indo-Pacific area to Polynesia and the Southern Sea of Japan. Only one specimen was collected, and it is representative of the typical subspecies *helvola helvola* which occurs from the Southern Sea of Japan, Marianas to New Britain, North Malaysia and Cocos Island. The Schilders consider this species moderately common.

Cypraea (Erosaria) caputserpentis Linné 1758.

Native name: Siput Pantut Botel Kechil.

Abundant in the barrier pools, especially over the outer section. A large series of these were collected, and they well represent the subspecies or geographical race *reticulum* Gmelin 1791. The species as a whole has a wide range from East Africa to Polynesia. This race is known from S. W. Malaysia to Andaman Islands, N. W. Australia, New Britain and the Ryukyu Islands. It is a common reef shell. The young and immature specimens which have not laid down their heavy lip or dark adult spotings are characterized by a base colour of grayish brown with a single, darker chocolate brown, wide band running around the middle of the whorl. This band is later obscured by the mature pattern laid down by the mantle of the adult. These young were found under boulders on the outer barrier reef and as drift on the south and east coasts of the atoll.

Cypraea (Monetaria) annulus Linné 1758.

Native name: (Siput) Dakun Bélanda.

A fairly common reef species on Cocos Atoll, and abundant in many areas from South Africa to Polynesia. This is the typical subspecies which occurs from the Southern Sea of Japan south to Central Malaysia and to Andaman Island and N. W. Australia.

Cypraea (Monetaria) moneta Linné 1758.

Native name: Siput Dakun.

The money cowrie is probably the commonest of the smaller species in this genus. It appears to be a common shallow water, reef species on Cocos Atoll and in shallow, weedy areas in the lagoon. The lipless young are fragile, light canary yellow with two, sometimes three, narrow gray-brown bands widely separated on the whorl.

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Cypraea (Blasicrura) hirundo Linné 1758.

A single specimen was collected on the outer edge of the barrier reef near Pulo Gangsa, Cocos Atoll. This is a rare subspecies, (*hirundo hirundo*), with a range from the Persian Gulf to Ceylon and now Cocos-Keeling. The other three races mentioned by the Schilders appear to be moderately rare in other regions.

Cypraea (Luria) isabella Linné 1758.

Not uncommon as a shallow water reef and lagoon species on Cocos Atoll. This is a fairly common cowrie extending from East Africa to Polynesia. The lipless young are very distinct, being fragile, cylindrical in shape, a yellowish tan with 2 lighter bands on the middle of the whorl and a third narrower one just below the suture (next to the spire). The irregular, fine, black markings so characteristic of the adult are present in one of our young specimens.

Cypraea (Callistocypraea) testudinaria Linné 1758.

Native name: Siput Tuan.

Occasionally found alive in pools on the outer portion of the barrier reef on Cocos Atoll and as beach drift on North Keeling. This is a well known and widely distributed species, but is not often collected alive, since it appears to live in deeper waters on the outer edges of the reef and is only rarely found wandering on the face of the reef. The three races accepted by the Schilders do not seem well defined and as they say "need further research".

Cypraea (Mauritia) histrio Gmelin 1791.

Native name: Siput Pantut Botel Pérana'an.

Common on the reefs at Cocos Atoll. This is a typically Indian Ocean species, extending from East Africa to Java and N. W. Australia, but no further east. It was listed from Christmas Island by Tomlin as *Cypraea histrio* Dillwyn and by E. A. Smith (1900) as *Cypraea arabica* var. *reticulata*. No *Cypraea arabica* Linné, a common Indo-Pacific species, were in this Cocos-Keeling collection. *C. histrio* is uncommon in museum collections with good locality data.

Cypraea (Mauritia) depressa Gray 1824.

Native name: Siput Pantut Botel Pérana'an.

An abundant species on the reefs of Cocos Atoll. This was listed by Tomlin in his Christmas Island report as *Cypraea arabica* var. *gillei* Jousseaume 1893, but we agree with the Schilders that it is a distinct species and should have Gray's earlier name of *depressa* 1824. We are not convinced because

of lack of material before us that the two races accepted by the Schilders are valid, although Schilder records the geographical race or subspecies, *dispersa* Schilder 1939, from Cocos Island. The young of *depressa* and *histrio* appear to be too close in morphological characters to separate.

Cypraea (Mauritia) mauritiana Linné 1758.

Native name: Siput Pantut Botel.

Although this species is moderately common in the Indo-Pacific region, including the Malaysia area, Dr. Gibson-Hill notes that it is "definitely scarce" on the reefs at Cocos Atoll. Tomlin records it from Christmas Island but does not comment on its scarcity.

Cypraea (Cypraea) tigris Linné 1758.

Native name: Siput Géros.

The tiger cowrie is common on the reefs and lagoon of Cocos Atoll. Its range is from East Africa to Japan and Polynesia.

Cypraea (Cypraea) lynx Linné 1758.

"Fairly common on Cocos Atoll shallow water reefs." A common Indo-Pacific species.

Cypraea (Cypraea) vitellus Linné 1758.

"In pools under coral boulders on the outer portion of the barrier reef at the following localities: Pulo Tikus, Pulo Selma, Pulo Siput and Pulo Béras, all Cocos Atoll." Its range is in the Indo-Pacific.

Cypraea (Cypraea) carneola Linné 1758.

"Under coral boulders in the shallow waters of the reefs on Cocos Atoll, between Pulo Tikus and Pulo Béras." This is a common cowrie found from East Africa to Polynesia.

Family CASSIDIDAE

Casmaria vibex Linné 1758.

Three specimens were collected in shallow water in the vicinity of Pulo Béras. This fairly common species has a widespread Indo-Pacific distribution. Tomlin lists it from Christmas Island as *Phalium vibex* L.

Cassis (Cypraecassis) rufa Linné 1758.

Native name: Siput Elmat.

"This species, which is very scarce, is occasionally taken by night with the aid of a flare in the outer barrier pools mostly in the gap between Pulo Atas and Pulo Panjang." It is a common Indian Ocean species, but occasionally occurs in the Western Pacific.

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Family CYMATIIDAE

Cymatium chlorostoma Lamarck 1822.

A common Indo-Pacific species which is abundant at Cocos-Keeling.

Cymatium gemmatum Reeve 1844.

Not uncommon in the Indo-Pacific region.

Cymatium pyrum Linné 1758.

A single specimen from the outer portion of the fringing reef near Pulo Pasir. This is an uncommon species.

Cymatium lotorium Linné 1758.

A single specimen taken at a depth of two fathoms near a coral patch in the north-east corner of Cocos lagoon.

Cymatium vespaceum Lamarck 1822.

A rather uncommon species recorded from the Philippines and East Indies. Two species from the inner beach of Pulo Panjang.

Cymatium muricinum Röding 1798.

A single worn shell from the outer beach of Pulo Panjang. This is *C. nodulus* Link 1806, p. 122 and *C. tuberosum* Lamarck 1822.

Distorsio anus Linné 1758.

This is a handsome, widely distributed Indo-Pacific species. One specimen was brought up "in a fish trap from a depth of two fathoms, near a patch of coral in the north-east corner of the lagoon."

Charonia tritonis Linné 1758.

Native name: Siput Kong.

Not uncommon in shallow weedy water on the east side of the lagoon. Larger individuals occur in deeper water or on the barrier reef. This is a common Indo-Pacific species.

Linatella (Gelagna) clandestinum Lamarck 1816.

A single specimen was collected on the beach at Pulo Panjang. This is not a common species. It was described by Lamarck in 1816 as a *Triton* (Encycl. Meth. (Vers), pl. 433, Liste p. 8) and as a *Murex* by Dillwyn in 1817 (Cat. Shells, p. 723).

Family TONNIDAE

Tonna perdix Linné 1758.

Native name: Umpam Gatal-nya.

"Empty shells of this species are very plentiful in the barrier reef pools of Cocos Atoll." This is a widely distributed

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Indo-Pacific species, but has not been recorded from Christmas Island. The genera *Cadus* Röding 1798, *Dolium* Lamarck 1801, and *Cadium* Link 1807 are synonyms of *Tonna* Brünnich 1772.

Tonna olearium Linné 1758.

Native name and remarks the same as the preceding species. Only two specimens were in the Cocos-Keeling collection.

Malea pomum Linné 1758.

"Dead shells are fairly common on the outer shore of Cocos Atoll, but living specimens are rarely encountered." This is also a widely distributed species.

Family MURICIDAE

Murex (Chicoreus) ramosus Linné 1758.

A single worn specimen of this common Indo-Pacific species was collected on the lagoon side of Pulo Luar.

Murex (Chicoreus) torrefactus Sowerby 1840.

A single specimen was collected at Cocos-Keeling.

Drupa (Drupa) morum Röding 1798.

"Common on the fringing reefs of Cocos Atoll." This species is *D. horrida* Lamarck 1817 and *neritoides* Gmelin 1791 (non Linné 1758).

Drupa (Drupa) ricina Linné 1758.

A widely distributed, common Indo-Pacific species. *D. histrix* Linné 1758 is the same species.

Drupa (Drupa) rubusidaea Röding 1798.

This is *histrix* of Lamarck and authors. The last three *Drupa* species were recorded from Christmas Island by Tomlin.

Drupa (Morula) uva Röding 1798.

A common Indo-Pacific species of which Dr. Gibson-Hill says is "occasionally found among the coral rocks on the inner side of the barrier (reef), and along the lagoon shore of a number of the islands at the north end of the atoll." It is *nodus* Borv St. Vincent 1816 and *morus* Lamarck 1822.

Drupa (Morula) granulata Duclos 1832.

This common species was described a few months after Duclos as *tuberculata* by de Blainville 1832.

Drupa (Drupina) grossularia subspecies *lobata* Blainville 1832.

Four empty shells were collected on the outer beach of Pulo Panjang. *Drupa lobata* has been lumped with and split from

MOLLUSCAN FAUNA OF THE COCOS-KEELING ISLANDS

grossularia Röding 1798 (= *digitata* Lamarck 1816; *dactyloides* Schumacher 1817; *ricinus* Wood 1825, non Linné 1758) by various authors. We believe, however, that *lobata* is an excellent example of a geographic subspecies which is confined to the Indian Ocean. The only difference is in the bright yellow colour of the lip of *grossularia* and the dark chocolate colour of *lobata*. Tomlin records this species from Christmas Island, but followed Reeve in lumping the two forms, and did not state the colour of the lip.

Drupa (Cronia) fenestrata Blainville 1832.

A single specimen was collected on the beach of Pulo Panjang.

Nassa francolinus Bruguière 1789.

Two specimens were collected on the beach of Pulo Panjang. *Nassa sertum* Bruguière 1789 appears to be the same species. This is not *Nassa* Lamarck 1799 (= *Nassarius* Froriep 1806).

Purpura persica Linné 1758.

One specimen was collected on the south beach on North Keeling Island. For remarks on the use of this genus see W. J. Clench 1946, Johnsonia, Harvard College, vol. 2, no. 23, pp. 61-92.

Thais (Mancinella) armigera Link 1807.

Three live specimens were collected on the barrier reef of the atoll. Link in 1807 and Lamarck in 1822 gave this species the same name and referred to the same figure in Chemnitz's Conch. Cab. 11, pl. 187, figs. 1798 and 1799. Tomlin also records this widespread Indo-Pacific species as occurring on Christmas Island.

Family MAGILIDAE

Rapa rapa Linné 1758.

Although this is a widely distributed mollusc, it is by no means common in most Pacific areas. Five beach drift specimens were collected on the outer beaches of Pulo Panjang and Pulo Atas. Not recorded from Christmas Island.

Coralliophila erosa Röding 1798.

Cantharus erosus Röding 1798, Museum Boltenianum, 2, p. 133 (refers to Martini Conch. Cab., 3, pl. 100, figs. 954-955, East Indies).

Purpura galea Reeve 1846, Conch. Icon., *Purpura*, pl. 12, fig. 65, sp. 65, Luzon, Philippines (not *galea* of Chemnitz or authors).

Trichotropus dorbignyanum Petit de la Saussaye 1851, Journ. de Conch., 2, p. 261, pl. 7, fig. 2 (Pacific Ocean).

Coralliophila trichotropoides Montrouzier 1861, Journ. de Conch., 9, p. 284.

Rhizochilus exaratus Pease 1861, Proc. Zool. Soc. London, 1860, p. 399, no. 12 (Hawaiian Islands).

A single specimen was found on West Beach at Pulo Panjang. It is a widespread Indo-Pacific species, but its nomenclature has been so confused that we are listing its synonymy and that of the West Indian species. Should further work on animal characters show that these two forms are inseparable, the earliest name, that of *erosa* Röding 1798, will apply.

The synonymy of the Western Atlantic species (*Coralliophila abbreviata* Lamarck) includes:

Pyrula abbreviata Lamarck 1816, Ency. Method. (Vers), pl. 436, fig. 2a, 2b (refers to Chemnitz Conch. Cab., 10, p. 237 ("one from the East Indies, but most of mine from the West Indies"), pl. 160, figs. 1518, 1519).

Purpura scalariformis Lamarck 1822, Anim. sans Vert, 7, p. 241 (no locality). Type figured in 1835, Kiener Icon., 8, pl. 19, figs. 55 and 56.

Family COLUMBELLIDAE

Columbella turturina Lamarck 1822.

Empty shells of this widespread Indo-Pacific species were found in pools over the outer barrier reef between Pulo Tikus and Pulo Béras.

Pyrene obtusa Sowerby 1839.

A single specimen found in a barrier pool near Pulo Béras.

Family BUCCINIDAE

Engina lineata Reeve 1847.

"This species is occasionally found under coral boulders in pools on the outer portion of the barrier" reef at Cocos Atoll.

Cantharus (Pollia) undosus Linné 1758.

A widespread Indo-Pacific species which is plentiful at Pulo Panjang.

Cantharus (Pollia) fumosus Dillwyn 1819.

Several specimens of this species were collected with *C. undosus* Linné. I am uncertain whether or not to consider this species as merely a ribbed form of *C. undosus*. More material and field study will possibly answer the question. Reeve described *proteus* in 1846 (Conch. Icon.) which appears to be a synonym of *fumosus* Dillwyn. Reeve's *rubiginosus* 1846 from the Red Sea may prove subsequently to be a subspecies.

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Family NASSARIIDAE

Nassarius graniferus Kiener 1834.

Outer shore of Pulo Tikus and Pulo Gangsa.
Nassarius gaudiosus Hinds 1844.

In barrier reef pools between Pulo Tikus and Pulo Gangsa.
Nassarius papillosus Linné 1758.

Four specimens were collected at a depth of two or three fathoms inside Cocos lagoon. Although this large and beautiful species of *Nassarius* is not uncommon, very few museum lots possess specific locality data. It was also recorded from Christmas Island by Tomlin.

Family FASCIOLARIIDAE

Latirus polygonus polygonus Gmelin 1791.

A worn specimen found on West Beach at Pulo Panjang. The finest figure selected by Gmelin in his original description (Syst. Nat. 12th ed., p. 3555, no. 109) is his first reference, that of Lister 1770, pl. 922, fig. 15, Mauritius.

Latirus polygonus barclayi Reeve 1847.

"This species is fairly plentiful inside the lagoon in corally water at a depth of two to three fathoms." This "subspecies" is distinguished from *polygonus* Gmelin 1791 only by the absence of dark brown splotches on the axial ribs. The two forms occur together in Mauritius and Cocos-Keeling, but *barclayi* Reeve appears to occur alone in the Marshall Islands. Further study in the field is needed to clarify this complex.

Latirus nodatus Gmelin 1791.

Beach-worn specimens found at Pulo Panjang, on the outer shore.

Peristernia nassatula Lamarck 1822.

One specimen from Pulo Panjang.

Peristernia fragaria Wood 1828.

One specimen from Pulo Panjang. This is *bella* Reeve 1846.

Family OLIVIDAE

Oliva caerulea Röding 1798.

One specimen was collected on West Beach at Pulo Panjang. This is a common Indian Ocean species which is occasionally found in the East Indies, Formosa and the Philippines. The aperture is a deep bluish purple. It was named *episcopalis* by Lamarck in 1822.

Family MITRIDAE

Mitra episcopalis Linné 1758.

One specimen collected at Pulo Panjang.

Mitra (Strigatella) columbelliformis Kiener 1837.

Outer beaches at Pulo Panjang.

Mitra (Strigatella) paupercula Linné 1758.

"Found in shallow, slightly weedy water towards the north end of Pulo Panjang" and on the lagoon side of the barrier reef between Pulo Siput and Pulo Pandan.

Family XANCIDAE

Vasum turbinellum Linné 1758.

Common at West Beach, Pulo Panjang.

Family HARPIDAE

Harpa amouretta Röding 1798.

Apparently common at Cocos-Keeling. Four specimens in drift from North Keeling. This species had been more familiarly known as *minor* Lamarck 1822, and also named *oblonga* Schumacher 1817 and *solida* A. Adams 1853.

Family TURRIDAE

Lienardia species.

A single specimen with operculum still in place was recovered from the intestine of a holothurian by which it apparently had been recently ingested. The specimen measures 2.5 mm. in length and has a protoconch similar to those found in the genus *Lienardia* (subfamily Mangeliinae). The shell is closest to *L. multinoda* Hedley 1922, but I hesitate to describe a new species from only one example. (see Hedley, 1922, Rec. Austr. Mus. 13, pl. 49, fig. 97). "*Clathurella*" *spyridula* Melville and Standen 1896 from Lifu Island (Journ. Conch., 8, p. 296, pl. 10, fig. 42) is somewhat like it also, but type material would certainly have to be examined.

Family CONIDAE

The genus *Conus* is well represented in this Cocos-Keeling collection. Although four highly venomous species were included, Dr. Gibson-Hill tells me that he never heard of a native being stung, and that these molluscs were not included in the accounts which they gave him of noxious animals. The natives apparently use the name of "Lok-lok" indiscriminately for all cone-shaped shells. All the specimens were collected on the outer shores of the main Atoll.

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Conus litteratus Linné 1758.

Conus marmoreus Linné 1758.

This species has been known to inflict a fatal sting in the Indo-Pacific region.

Conus betulinus Linné 1758.

Native name: Lok-lok Bēsar.

Two very large specimens (5 inches in length) were sent to us. "This species is fairly common in shallow, weedy water inside the lagoon." *C. betulinus* is typically an Indian Ocean species, ranging from Africa to Singapore but extends sporadically into the East Indies and as far north as the Mariana Islands.

Conus imperialis Linné 1758.

Conus vexillum Gmelin 1791.

A single fresh specimen of this widely distributed Indo-Pacific species was collected.

Conus ebraeus Linné 1758.

Erroneously emended by authors to *hebraeus*.

Conus chaldeus Röding 1798.

This is *C. vermiculata* Lamarck 1810. It may possibly be a form of *ebraeus* Linné. A study of living specimens should be made in the field.

Conus sponsalis Hwass 1792.

Corus miliaris Hwass 1792.

Conus flavidus Lamarck 1810.

Conus lividus Hwass 1792.

Conus catus Hwass 1792.

Conus arenatus Hwass 1792.

Conus pulicarius Hwass 1792.

Conus textile Linné 1758.

This species of cone shell has been known to inflict a fatal sting in the Indo-Pacific region.

Conus aulicus Linné 1758.

This is also a very venomous species. The single specimen collected by Dr. Gibson-Hill is unusually large with a length of 5.6 inches.

Conus tulipa Linné 1758.

This species has been known to inflict a fatal sting in the Indo-Pacific region.

Family TEREBRIDAE

Terebra (Subula) crenulata Linné 1758.

Four specimens were found on the lagoon side at the north end of Pulo Panjang, Cocos Atoll. Both the typical form and the less crenulated, invalid form named "*fimbriata* Deshayes" were collected.

Terebra (Subula) dimidiata Linné 1758.

Outer beaches at Pulo Panjang.

Terebra (Subula) maculata Linné 1758.

Outer beaches at Pulo Panjang.

Terebra (Impages) hectica Linné 1758.

Outer beaches at Pulo Panjang. This is a very variable species in the amount of bluish gray bands and subsutural brown streaks. *T. caerulescens* Lamarck 1822 is a synonym. The single Cocos-Keeling specimen approaches the form "*alba*" Dautzenberg 1935" which was figured by Reeve 1860, pl. 7, fig. 26c.

Family HYDATINIDAE

Hydatina physis Linné 1758.

Five specimens were taken in pools on the outer section of the barrier reef between Pulo Gangsa and Pulo Selma. This is a common Indo-Pacific Opisthobranch.

Family BULLIDAE

Bulla ampulla Linné 1758.

This common Indo-Pacific species is plentiful in pools over the middle and outer section of the barrier reef at Cocos Atoll.

Family ELLOBIIDAE

Melampus luteus Quoy and Gaimard 1832.

This common Indo-Pacific species "is usually found in dampish spots under the upper layer of coral debris which forms the greater part of the surface of the islands. It is plentiful on North Keeling, and in the main atoll on Pulo Panjang."

Melampus fasciatus Deshayes 1830.

Auricula fasciata Deshayes 1830, Ency. Meth. (Vers) 2, (1), p. 90.

A common widely distributed species in the Indo-Pacific area. It may be distinguished from *M. fuscus* by the presence of brown or yellowish spiral colour bands and the distinct microscopic axial ribs on the early whorls.

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Melampus fuscus Philippi 1844.

Voluta castanea Muhlfeld 1818, in Mag. Ges. nat. Fr. Berl., 7, p. 4,
pl. 1, fig. 2 (Non Megerle 1816; non Dillwyn 1817).

Auricula fusca Philippi 1844, in Martini-Chemnitz, Syst. Conch. Cab.,
ed. 2, Auriculacea (49), p. 38.

This common species is often confused with *M. fasciatus*, but may be separated by the absence of minute axial ribs on the early whorls which are replaced by raised spiral threads. Banding is subdued so that the shell appears to be a uniform yellowish brown to chocolate brown.

Pythia species.

A single worn specimen, measuring 17 mm. in length, was found on a beach at Cocos-Keeling. It seems to be a diminutive species related to *scarabaeus* Linné. It is closest to *P. crosseana* Gassies 1870 which was described from Ouvea in the Loyalty Islands. It is not known whether or not this genus is found alive on Cocos-Keeling.

Family SUCCINEIDAE

Four specimens of *Succinea* were collected by Dr. Gibson-Hill on North Keeling Island. We have compared these specimens with those fully described and figured by H. E. Quick (1939) and consider them quite different in anatomical features from any species hitherto described.

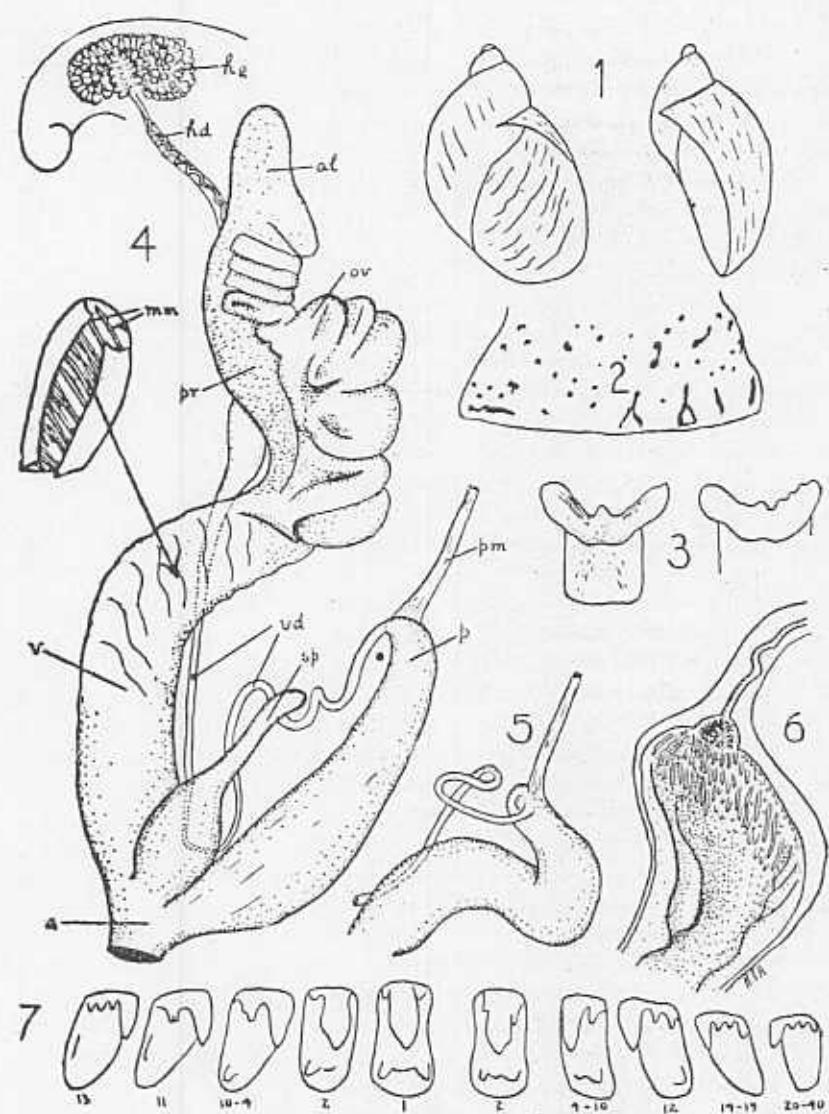
Succinea keelingensis new species.

(Text figs. 1-7).

Shell (fig. 1) similar to *Succinea solitaria* Smith, fragile and coloured a pale yellowish horn. Apex moderately acute. Adults with $2\frac{1}{2}$ whorls. The lines of growth are very coarse, irregular and often tinged a dark brown. A very fine peristral sculpture in the form of minute, obliquely decussate, incised lines may be seen in favourable light and high magnification. The intersection of these lines forms microscopic rhombic granulations.

The jaw (fig. 3) measures 1.0 x 0.9 mm., is dark brown in colour with the central projection prominent, broad and rounded. The diverging arms are minutely striated vertically and with an internal horizontal striation near the cutting edge. An aberrant or worn jaw is figured to the right of the normal one.

The radula (fig. 7) measures 3.0 x 1.0 mm. and has 80 to 82 transverse rows of teeth. The central tooth is not unusually large as in *S. norfolkensis*. Two basal projections are prominent in the central tooth, and they gradually reduce to one by the tenth marginal tooth and disappear completely by the fourteenth. The formula is 30-10. c. 10-30 x 80.



Succinea keelingensis Abbott.

The explanation of the figures is given in the note at the bottom of the opposite page.

MOLLUSCAN FAUNA OF THE COCOS-KEELING ISLANDS

The animal preserved in alcohol has a mantle which is clear with about 200 small irregular dots and streaks of dark brown (fig. 2). The sides of the foot are speckled with dark brown. The dorsal neck region is suffused with two longitudinal bands of blackish brown.

The reproductive system (fig. 4) is typical of *Succinea* but with an unusual spermatheca, vagina, hermaphroditic duct. The hermaphroditic gland or gonad is globular in shape, with its capsule unpigmented, and its follicles club-shaped. The hermaphroditic duct is not bulky, but only slightly coiled in the central part of its course. It is unpigmented. It joins the lower end of the light brown albumen gland. The oviduct is brownish cream coloured, large and heavily convoluted. The vagina at its upper end has a creased appearance due to the diagonal folds of the mucus membranes within. The lower end of the vagina is cylindrical and is joined near the atrium by the spermatheca. The spermatheca is very bulbous at its base of attachment and bears a narrow single tube distally which unlike most of such organs in *Succinea* is not swollen into a bulb at its free end. The penial sheath of two different animals are shown in figures 4 and 5. The vas deferens is coiled back on itself soon after it leaves the penial sheath. The interior of the penis (fig. 6) has at its upper end a number of small, fleshy papillae. Three or four folds are present below this. No crystals were found. No penial appendix was found. The above anatomical notes and accompanying drawings were based on three individuals.

Measurements of shell:—

length (mm.)	width (mm.)	
11.5	7.5	Holotype U.S.N.M. No. 488579.
11.0	7.0	Paratype U.S.N.M. No. 488580.
10.0	7.5	Raffles Museum. ^{CR 1975.4.25.21}
9.5	6.0	British Museum.

Succinea keelingensis Abbott.

- Fig. 1. Two views of holotype shell (11.5 × 7.5 mm.).
 Fig. 2. Dorsal view of anterior half of mantle.
 Fig. 3. Dorsal views of two jaws (1.0 × 0.9 mm.).
 Fig. 4. Reproductive system. a = atrium; al = albumen gland; hd = hermaphroditic duct; hg = hermaphroditic gland or gonad; mm = fold of the mucus membranes in the vagina; ov = oviduct; p = penial sheath; pm = penial retractor muscle; pr = prostate gland; sp = spermatheca; v = vagina; vd = vas deferens.
 Fig. 5. Penial sheath, penial retractor muscle and vas deferens of another individual.
 Fig. 6. Sagittal section of penis.
 Fig. 7. Selected teeth from the radula. 1 = central. Other numbers refer to the number of rows removed from the central, no. 40 being the outermost marginal.

Type locality: North Keeling Island, Cocos-Keeling Islands, Indian Ocean. C. A. Gibson-Hill, collector. August 1941. Field No. 151.

Types: Holotype in the United States National Museum No. 488579. A paratype in United States National Museum No. 488580, the British Museum No. 1948. 6. 29. 1 and the Raffles Museum.

Remarks: This species appears to belong to true *Succinea* and not to the closely related genera *Oxyloma* and *Quickella* as discussed in Pilsbry's monumental monograph (1948, pp. 771-847). The shell of *S. keelingensis* is quite similar to *S. solitaria* Smith from Christmas Island. The latter appears from the descriptions by Smith (1887) and Quick (1939) to be less coarsely striated and to be a more slender shell than that of the Cocos-Keeling species. More significant differences exist in the radulae. The central in *solitaria* (as figured by Quick 1939) is almost square in contrast to the oblong shape in *keelingensis*. The latter bears prominent basal projections as shown in figure 7. The narrow distal end of the spermatheca seen in all four dissected specimens is rather outstanding, although there is a possibility that this is a variation due to sexual season or preservation. If the shape of the jaw is considered of systematic importance, it may be said that the *keelingensis* jaw is not nearly as squat and compact as that of *S. solitaria*. As Pilsbry points out, an extensive anatomical survey is needed of the Succineas from a worldwide standpoint.

Family VERTIGINIDAE

Gastrocopta species.

A single, brown coloured specimen, too damaged to allow for precise identification, was collected on Cocos-Keeling.

Family ZONITIDAE

Subfamily MICROCYSTINAE

Liardetia (Liardetia) sculpta Moellendorff 1833. Text figure 8.

Dr. Gibson-Hill says "this species is found under the bark of dead or dying trees and, occasionally in rotting wood. It is not very plentiful."

We are including a drawing of the genitalia and mantle of this interesting little shell, since these characters are used in the identification of zonitids. The largest shell measures 3.5 mm. in its maximum diameter and 2.75 mm. in altitude. There are about 16 to 17 strong axial riblets per mm. on the 5th whorl. The United States National Museum contains 9 Moellendorff cotypes from Macao (no. 195981). This species has been

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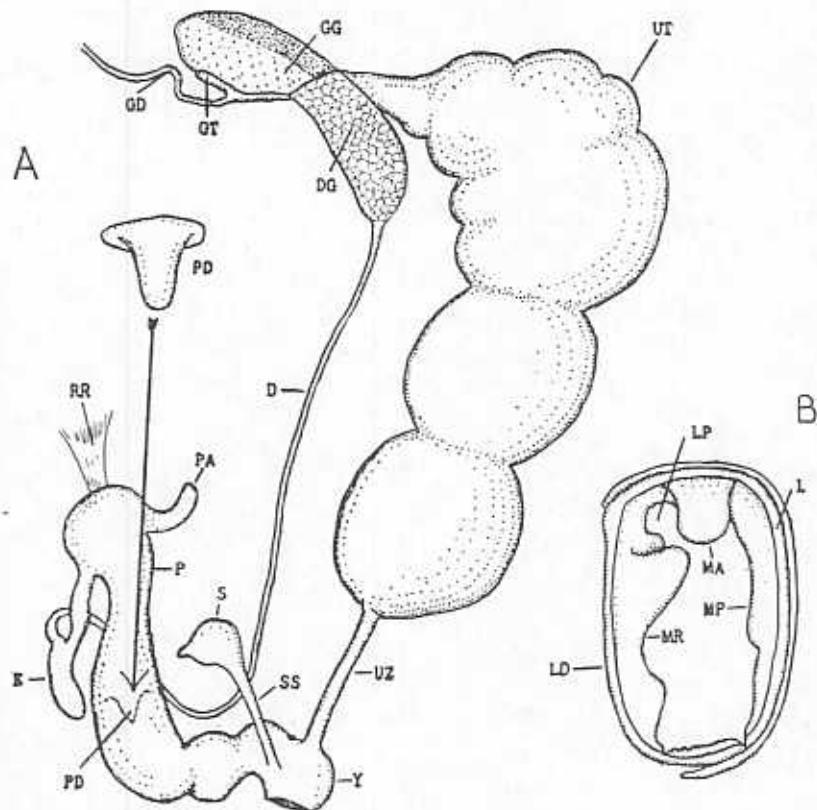
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Text figure 8.
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BULL. RAFFLES

figured by Moellendorff (Jahrb. Deutsch Malak. Ges., 12, pl. 10, fig. 11), and H. B. Baker (Bull. B. P. Bishop Mus., 158, 1938, pl. 14, fig. 6, pl. 9, fig. 8). North Keeling is the most southwesterly point that this species occurs. Baker (loc. cit.) records it from Kwantung, China; Shaming near Macao; Guam, Mariana Islands; Ponape, Caroline Islands.



Text figure 8. *Liardetia (Liardetia) sculpta* Moellendorff.

- A). Genitalia. D = vas deferens; DG = prostatic gland; E = epiphallus; GD = hermaphroditic duct; GG = albumen gland; GT = talon; P = penial sheath; PA = penial appendix; PD = penial stimulator papilla; RR = penial retractor muscle; S = spermatheca; SS = spermathecal stalk; UT = uterus; UZ = post-uterine oviduct; Y = atrium.
- B). Mantle collar. L = left shell-lap; LD = right shell-lap; LP = pneumostome; MA = anterior left mantle lappet; MP = posterior left mantle-lappet; MR = right mantle lappet.

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Family ACHATINIDAE

Subfamily SUBULININAE

Subulina octona Bruguière 1792.

This neotropical species is apparently well established on Cocos-Keeling where it was probably brought in on plants from some other British colony.

Lamellaxis (Allopeas) gracilis Hutton 1834.

Found with the above species, and also a widely dispersed snail which is encountered in gardens and greenhouses. Both species are fully treated in Pilsbry's Land Mollusca of North America, Acad. Nat. Sci. Philad., 1946, 2, pt. 1.

Class LAMELLIBRANCHIATA

Family ARCIDAЕ

Barbatia decussata Sowerby 1833.

Native name: Kupu Batu.

"A single specimen was found under a coral boulder in the middle section of the barrier near Pulo Béras." It is a common Indo-Pacific species.

Family MYTILIDAE

Volsella moduloides Röding 1798.

Musculus modulaides Röding 1798 [sic], Museum Boltenianum, 2, p. 157 (refers to Chemn. fig. 760).

Modiola albicosta Lamarck 1819, Anim. S. Vert. 6, p. 111, no. 3, (Eastern seas of India, Timor, and New Caledonia); type figured by Delessert, 1841, Rec. Coq. descr. Lam., pl. 13, figs. 8 a-b.

Modiolas microptera Deshayes 1836, Nat. Hist. Anim. S. Vert, ed 2, 7, p. 27 (refers to Chemn. fig. 760).

Modiola philippinarum Hanley 1843, Ill. Cat. Bivalves (3), p. 235; fig. in Appendix, pl. 24, fig. 26 (Philippines); P.Z.S. London, 1844, p. 15 (Cebu, P.I.).

A number of specimens were collected at Pulo Panjang, Cocos Atoll. There has been considerable confusion concerning the early names of this species, and even today there is legitimate doubt as to the variational limits of this mussel. Ecological variants appear to exist, but none have been carefully studied in the field. The earliest figure I can find is that of Chemnitz in Conch.-Cab. 8, pl. 85, fig. 760 with its locality as Coromandel Peninsula (India). The reasonably certain synonyms are listed above (see also Lamy, Bull. Mus. Nat. d'Hist. Nat. Paris, 26, p. 65, (920)). We have emended Röding's typographical error *modulaides* to *moduloides*.

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The following species are probably synonyms, but further study of types, speciation and ecological influences is required before definitely submerging these names. For a "splitters" point of view see Iredale 1939, Gt. Barrier Reef Exp., 5, no. 6, p. 412.

Modiola auriculata Kraus 1848, Sudafr. Moll., p. 20, pl. 2, fig. 4 (Natal; Red Sea; Anjouana Id.).

Modiola metcalfei Hanley 1843, Ill. Cat. Bivalves (3), p. 235; Appendix, p. 387, pl. 24, fig. 25 (Philippines); 1844 Proc. Zool. Soc. London, p. 15.

Modiola rumpfii Philippi 1847, Zeitschr. für. Mal., 4, p. 114 (East Indies. Refers to Rumph. Amb., pl. 46, fig. B).

Modiola traillii Reeve 1857, Conch. Icon., *Modiola*, sp. 13, pl. 4, figs. 13 and 14 (Malacca).

Modiolus agripeta Iredale 1939, Gt. Barrier Reef. Exp., 5, no. 6, p. 412, pl. 6, fig. 21 (Low Isles, Queensland).

Lamy also believes that *Modiola semifusca* Lamarck 1819 (Anim. S. Vert., 6, p. 113: Ile de France?) is the same as *auriculata* Kraus, but as Iredale states, "that conclusion is doubtful until the original specimen is re-examined in the Royal Scottish Museum at Edinburgh."

Family ISOGNOMONIDAE

Isognomon (Melina) *perna* Linné 1758.

Native name: Tiram Batu.

"This species, which is fairly plentiful, is found under coral boulders on the middle and outer portions of the barrier. It is occasionally eaten."

Family PTERIIDAE

Pinctada margaritifera Linné 1758.

Native name: Tiram Bulat.

"This species, which is scarce, can occasionally be found amongst coral rock, inside the lagoon" at Cocos Atoll.

Pteria penguin Röding 1798.

A single specimen was collected from Cocos Atoll. This is *P. macroptera* Lamarck 1819.

Electroma smaragdina Reeve 1857.

A few specimens of this delicate mussel were collected among the corals in the beds of Karang Kikir and Karang Kuning, Cocos Atoll. Two specimens were found attached to the coral *Seriatopora*.

Family PINNIDAE

Pinna (Pinna) muricata Linné 1758.

Native name: Tiram Lumut.

This common, widespread Indo-Pacific species "is very plentiful in certain patches of shallow, weedy water towards the south end of the lagoon, particularly that lying internal to Pulo Siput." R. Winckworth (1929) has an excellent account of the genus *Pinna* which we have followed.

Pinna (Atrina) vexillum Born 1778.

Native name: Tiram Bésar.

This species "which is scarce, is found in sandy water of a depth of four to five fathoms, inside the lagoon. Its flesh is edible." The specimen sent to the United States National Museum is a little over a foot in length.

? *Pinna (Streptopinna) saccata* Linné 1758.

A single young specimen of *Pinna* was included in the collection which is probably referable to this species.

Family PECTINIDAE

Spondylus histrix Röding 1798.

An excellent specimen was collected on Cocos Atoll. Tomlin recorded it from Christmas Island.

Family OSTREIDAE

Ostrea cucullata Born 1778.

A single specimen was collected on the reefs at Cocos Atoll. This common Indo-Pacific oyster was also named *plicatula* Gmelin 1791 and *purpurea* Humphreys 1786, Portland Cat., p. 139, no. 3091.

Pycnodonta species.

A single specimen which we leave undetermined until the appearance of the monograph on the world oysters now in preparation by Dr. Gilbert Ranson of the Muséum National d'Histoire Naturelle, Paris, France.

Family CARDITIDAE

Cardita (Cardita) variegata Bruguière 1792.

A beach worn valve was collected on one of the beaches of the atoll.

Family TRAPEZIIDAE

Trapezium oblongum Linné 1758.

Chama oblonga Linné 1758, Syst. Nat. ed. 10, p. 692, no. 136 (no locality).

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- Chama oblonga* Linné 1767, Syst. Nat. ed. 12, p. 1139, no. 163.
Cardita carinata Bruguière 1792, Ency. Meth. (Vers), 1, p. 409, no. 9 (refers to Linné's *oblonga* and Chemn. Conch., 7, pl. 50, figs. 504, 505).
Corbula tumida Röding 1798, Mus. Bolten, 2, p. 185 (refers to Chemn. Conch., 7, pl. 50, fig. 505).
Chama guinaica Lamarck 1819, Anim. S. Vert., 6, (1), p. 28 (refers to Linné's *oblonga* and Chemn. Conch., 7, pl. 50, figs. 504, 505).
Cypriocardia rostrata Lamarck 1819, Anim. S. Vert., 6, (1), p. 28.
Cypriocardia californica Conrad 1837, Journ. Acad. Nat. Sci. Phil., 7, p. 236, pl. 18, fig. 4 (San Diego and Santa Barbara (error)).
Cypriocardia duperreyi Deshayes 1839, Rev. Zool. Soc. Cuv., p. 359; 1841, Mag. de Zool. (Guerin), p. 27, pl. 27.
Cypriocardia oblonga Linné, Reeve 1843, Conch. Icon., pl. 1, figs. 4 a-b (New Holland; Philippines).
Cypriocardia guinaica Lamarck, Reeve 1843, Conch. Icon., *Cypriocardia*, pl. 2, fig. 13, sp. 13 (Lord Howe Id., Pacific).
Cypriocardia angulata Sowerby 1887, A Conch. Manual, p. 139, pl. 6, fig. 125 (Pacific Ocean) (non Lamarck 1819).

Native name: Kupu Batu.

This widely distributed species is "fairly plentiful under coral boulders of the reefs of Cocos Atoll. It is occasionally eaten." Tomlin records this species from Christmas Island. He also records *T. bicarinatum* Schumacher (as *angulatum* Lamarck) which, however, has not been collected at Cocos-Keeling.

Since the literature is scattered and confusing on these two species, we are including a list of synonyms for each. Dall, Bartsch and Rehder (Bull. 153, Bishop Museum, 1938, p. 123) kept *T. californicum* Conrad separate from *oblongum* Linné because the former is "lacking the brilliant red colour on the inside and details in sculpture." I have reexamined the material and find no constant difference in sculpturing. Several of the Hawaiian specimens have as much, and even more, red colouring than a few of the South Pacific specimens. The Cocos Atoll specimens show variability from white to rosy red on the interior of the shell.

The genus *Trapezium* was described in 1811 by Megerle von Mühlfeld and thus antedates *Cypriocardia* Lamarck 1819 and *Libitina* Schumacher 1817.

T. oblongum is separated from *bicarinatum* Schumacher by its larger and more swollen posterior end which is often recurved ventrally and by the occasional presence of rosy red splotches on the central part of the interior of the shell. *T. bicarinatum* is generally a smaller shell with its posterior end not pointed down, and sometimes in young specimens pointing dorsally. When colour is present it is in the form of deep purple stains on the posterior third of the interior of the shell.

Trapezium bicarinatum Schumacher 1817.

Libitina bicarinata Schumacher 1817, *Essai Vert. Test.*, p. 169, pl. 17, figs. 2 a-b (refers also to *Chemn. Conch.* 11, figs. 1993-1994).

Cypriocardia angulata Lamarck 1819, *Anim. S. Vert.* 6 (1), p. 28.
Cypriocardia angulata Lamarck, Deshayes 1834, *Anim. S. Vert.*, ed 2, 6, p. 438 refers to *Chemn. Conch.* 11, pl. 203, figs. 1993, 1994 (New Caledonia and China Seas).

Cypriocardia angulata Lamarck Reeve 1843, *Conch. Icon. Cypriocardia*, pl. 1, fig. 2, sp. 2.

Cypriocardia rostrata Lamarck, Reeve 1843, *Conch. Icon. Cypriocardia*, pl. 1, fig. 3, sp. 3 (New Holland; Philippines).

Not found at Cocos-Keeling by Dr. Gibson-Hill.

Family LUCINIDAE

Codakia punctata Linné 1758.

Native name: Sēndok-sēndokan.

"This species, which is fairly plentiful, is found in sandy, shallow water inside the barrier, mostly towards the south end of the lagoon." It is widely distributed Indo-Pacific species.

Lucina (Lucina) edentula Linné 1758.

Native name: Kupu Pasir.

Three specimens with the yellow periostracum still in place were collected at the south end of the lagoon. The genus *Anodontia* Link 1807 is a synonym of *Lucina* Lamarck 1799.

Family KELLIIDAE

Hitia ovalis Dall, Bartsch and Rehder 1938.

A single, fresh specimen was collected on the oceanside beach at Pulo Panjang. The types of *ovalis* in the United States National Museum were labelled by Pease as coming from "Sandwich Islands," but since then no other specimens have been sent in from the Hawaiian Islands.

Family CHAMIDAE

Chama aspersa Reeve 1846.

A single specimen was found on the reefs at Cocos Atoll. We have not attempted to delve into the complex nomenclature of the Indo-Pacific *Chama*, and have used the above name, since our specimen is almost identical to *Conch. Icon.*, *Chama*, pl. 5, fig. 24, *C. aspersa* Reeve. Tomlin records *C. brassica* Reeve from Christmas Island and our specimen may belong to that species.

Family CARDIIDAE

Fragum fragum Linné 1758.

A single valve from Cocos Atoll.

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Family TRIDACNIDAE

Tridaena crocea Lamarck 1819.

Native name: Kima.

"Clams are very plentiful over the middle and inner portions of the barrier; they also occur in some of the coral patches inside the lagoon, and in certain of the shallow, sandy areas. They are much sought by the Malays, who eat the flesh boiled or in curry or as soup. They also dry it for unofficial export to Singapore."

Family VENERIDAE

Pitar (Pitarina) prora Conrad 1837.

Cytherea prora Conrad 1837, Journ. Acad. Nat. Sci. Phila., 7, p. 253, pl. 19, fig. 18 (Pacific, probably coast of New Holland).

One specimen was collected in the lagoon. The anterior end of our specimen is more pinched and narrower than the one figured by Conrad, but appears to come within the limits of variation as shown in our main collection.

Venus (Periglypta) puerpera Linné 1771.

Native name: Kupu Pasir.

"This species occurs principally on the inner side of the barrier at the south end of the atoll." It is a widely distributed species of the Indo-Pacific region.

Paphia (Tapes) literata Linné 1758.

A single worn specimen from the south end of Cocos lagoon.

Family SANGUINOLARIIDAE

Asaphis deflorata Linné 1758.

A single specimen came from the south end of the lagoon. We agree with C. H. Oosting (Report on a Collection of Recent Shells from Obi and Halmahera, Med. Landb. Wagen, 29 (1), p. 311-316), who gives a very complete synonymy, that the Pacific and Western Atlantic specimens are the same species. When or if a difference can be demonstrated, it would be wise perhaps to retain the name *deflorata* for the Western Atlantic specimens and apply the next earliest available name to the Pacific specimens (*Venus violascens* Forskal 1775, Descriptiones Animalium quae in itinere Orientali observavit, p. 31, no. 28, p.).

Family TELLENIDAE

Arcopagia (Scutarcopagia) scobinata Linné 1758.

Native name: Kupu Pasir.

"This species occurs in the middle and inner barrier pools, especially at the south end of Cocos Atoll." Also from Christmas Island.

Tellina (Tellinella) crassiplicata Sowerby 1869.

Two specimens of this fairly common *Tellina* were collected on the inner beach of Pulo Panjang.

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